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FORM PTO-1390 (REV 12-29-99) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER 42014

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U S APPLICATION NO (If known, see 37 CFR 1 5) 09/913403

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/00486	January 22, 2000	February 15, 1999

TITLE OF INVENTION
METHOD AND DEVICE FOR PRODUCING FASTENER PARTS FROM RADIATION CURED PLASTIC MATERIALS

APPLICANT(S) FOR DO/EO/US
Konstantinos Poulakis

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☑ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☑ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☑ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☑ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☑ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☑ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☑ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☑ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☑ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☑ Other items or information:

Translation of Preliminary Examination Report

533 Rec'd PCT/PTO 14 AUG 2001

U.S. APPLICATION NO (if known, see 37 CFR 1.5) 09/913403	INTERNATIONAL APPLICATION NO PCT/EP00/00486	ATTORNEY'S DOCKET NUMBER 42014

17. ☑ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**

				CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	X **$18.00**	$	
Independent claims	1 - 3 =	0	X **$80.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$270.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction of 1/2 for filing by small entity, if applicable.				$	
SUBTOTAL =				$.	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$.	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 40.00	
TOTAL FEES ENCLOSED =				$ 900.00	
				Amount to be refunded:	$
				charged:	$

a. ☑ A check in the amount of $ 900.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. ________ in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 18-2220. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

Mark S. Bicks

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SIGNATURE

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NAME

28,770

REGISTRATION NUMBER

42014

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	PATENT
Konstantinos Poulakis	:	
Serial No.: ______________	:	Group Art Unit:
Filed: Herewith	:	Examiner:

For: METHOD AND DEVICE FOR PRODUCING FASTENER PARTS FROM RADIATION CURED PLASTIC MATERIALS

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Preliminary to examination and calculation of the filing fee, please amend the above-identified application as follows:

In the Claims

Amend claims 3, 4, 5, 7 and 9 as follows.

3. The process as claimed in claim 1, characterized in that the formulation encompasses reactive diluents, preferably monomers, particularly preferably acrylates, the acrylates preferably being monofunctional acrylates from the group consisting of butyl acrylate, 2-ethylhexyl acrylate, hydroxyethyl acrylate, hydroxypropyl acrylate, 4-hydroxybutyl acrylate, ethyl diglycol acrylate, isodecyl acrylate and 2-ethoxyethyl acrylate, and the bifunctional acrylates being from the group consisting of diethylene glycol diacrylate, dipropylene glycol diacrylate, triethylene glycol diacrylate, tripropylene glycol diacrylate and 1,6-hexanediol diacrylate, and the trifunctional acrylates being from the group consisting of trimethylolpropane triacrylate and pentaerythritol triacrylate, and particular preference being given to 2-ethoxyethyl acrylate, isodecyl acrylate, 1,6-hexanediol diacrylate and trimethylolpropane triacrylate.

4. The process as claimed in claim 1, characterized in that the radiation curing takes place by way of an electron beam.

5. The process as claimed in claim 1, characterized in that the radiation curing takes place by way of UV radiation, and the formulation preferably also encompasses at least one photoinitiator.

7. The process as claimed in claim 1, characterized in that the molding, casting or compression molding takes place in a gap (16) between a shaping roll (11) and a backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), where the interlocking means (24) or the protruding elements are formed during passage through the gap (16).

9. An apparatus for producing cling fasteners as claimed in claim 1, characterized in that the apparatus encompasses a means of feeding (32, 10) for the formulation (14) encompassing radiation-crosslinkable, in particular acrylic, prepolymers, and encompasses at least one shaping roll (11) and one backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), and that there is a source of UV radiation (19), or an electron-beam source, for the radiation curing of the molded radiation-curable formulation.

REMARKS

The above changes eliminate multiple dependency in the claims.

Respectfully submitted,

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Dated: Aug 13, 2001

The materials preferably used in the conventional processes are thermoplastics such as polypropylene, polyamide or polyethylene.

A process of this type is known from WO 98/20767, for example.

High nip pressures of from about 500 N/m to some thousands of N/m are required in order to achieve

AMENDED SHEET

provision of cling-fastener parts with greater heat resistance, and also of film structures with extremely low thickness, while providing a large number of protruding elements or interlocking means.

AMENDED SHEET

Marked-up copy of Claims
533 Rec'd PCT/PTO 14 AUG 2001
09/913403

What is claimed is

1. A process for producing cling-fastener parts with a large number of interlocking means (24), characterized in that a formulation encompassing radiation-crosslinkable prepolymers is molded, cast, and/or compression molded into the shape of a large number of interlocking means (24) together with a cling-fastener base (21), and is then radiation-cured.

2. The process as claimed in claim 1, characterized in that the radiation-crosslinkable, in particular acrylic, prepolymers are selected from the group consisting of polyester acrylates, epoxy acrylates, polyether acrylates, silicone acrylates and urethane acrylates, the urethane acrylates preferably being aliphatic mono-, bi- or trifunctional urethane acrylates.

3. The process as claimed in claim 1 ~~or 2~~, characterized in that the formulation encompasses reactive diluents, preferably monomers, particularly preferably acrylates, the acrylates preferably being monofunctional acrylates from the group consisting of butyl acrylate, 2-ethylhexyl acrylate, hydroxyethyl acrylate, hydroxypropyl acrylate, 4-hydroxybutyl acrylate, ethyl diglycol acrylate, isodecyl acrylate and 2-ethoxyethyl acrylate, and the bifunctional acrylates being from the group consisting of diethylene glycol diacrylate, dipropylene glycol diacrylate, triethylene glycol diacrylate, tripropylene glycol diacrylate and 1,6-hexanediol diacrylate, and the trifunctional acrylates being from the group consisting of trimethylolpropane triacrylate and pentaerythritol triacrylate, and particular preference being given to 2-ethoxyethyl acrylate,

isodecyl acrylate, 1,6-hexanediol diacrylate and trimethylolpropane triacrylate.

4. The process as claimed in ~~any of~~ claim~~s~~ 1 ~~to 3~~, characterized in that the radiation curing takes place by way of an electron beam.

5. The process as claimed in ~~any of~~ claim~~s~~ 1 ~~to 3~~, characterized in that the radiation curing takes place by way of UV radiation, and the formulation preferably also encompasses at least one photoinitiator.

6. The process as claimed in claim 5, characterized in that the photoinitiator is selected from the group consisting of α-hydroxyketones, α-aminoketones, dimethylketals of benzil, bisbenzoylphenylphosphine oxides, metallocenes, and derivatives of these, and is preferably 2-hydroxy-2-methyl-1-phenylpropan-1-one.

7. The process as claimed in ~~any of~~ claim~~s~~ 1 ~~to 6~~, characterized in that the molding, casting or compression molding takes place in a gap (16) between a shaping roll (11) and a backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), where the interlocking means (24) or the protruding elements are formed during passage through the gap (16).

8. The process as claimed in claim 7, characterized in that the viscosity of the formulation at 25°C is from 150 to 20,000 mPa.s, preferably from 300 to 5,000 mPa.s.

9. An apparatus for producing cling fasteners as claimed in ~~any of~~ claim~~s~~ 1 ~~to 8~~, characterized in that the apparatus encompasses a means of feeding (32, 10) for the formulation (14) encompassing

radiation-crosslinkable, in particular acrylic, prepolymers, and encompasses at least one shaping roll (11) and one backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), and that there is a source of UV radiation (19), or an electron-beam source, for the radiation curing of the molded radiation-curable formulation.

533 Rec'd PCT/PTO 14 AUG 2001

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09/913403

Date: February 19, 1999

Our reference: 53 821

Applicant: Binder Kletten-Haftverschluβ-Systeme GmbH
Kamenzer Straβe 19, 01896 Pulsnitz

Process and apparatus for producing cling-fastener parts made from radiation-cured plastics

The present invention relates to a process and an apparatus for producing cling-fastener parts which have a large number of interlocking means.

Known cling-fastener parts are produced from thermoplastic polyolefins by extrusion. Here, the thermoplastic, in the plastic or liquid state, is fed, for example, to a gap between a pressure roll and a shaping roll, the shaping roll having a large number of radial cutouts, both ends of which are open. The thermoplastic penetrates into the cutouts under the action of the nip pressure, and substantially cures, so that the cling-fastener parts, in the form of a three-dimensional structure, can be released from the shaping roll. The cling-fastener base is molded in the gap between the shaping roll and the pressure roll, the base and the interlocking means, specifically the interlock projections formed in the cutouts and the interlock tips formed, being one single bonded piece.

The materials preferably used in the conventional processes are thermoplastics such as polypropylene, polyamide or polyethylene.

A process of this type is known from WO 98/20767, for example.

High nip pressures of from about 500 kilogram/m to a few metric tons/m are required in order to achieve adequate supply of the plastic material, in its plastic

or liquid state, to the cutouts.

In addition, the relatively low cooling rate of the thermoplastic polymers means that only small meterages of the three-dimensional cling-fastener sheeting can be produced on a shaping roll of width about 400 mm.

Production of cling-fastener parts via extrusion of thermoplastics requires considerable energy cost, to heat the thermoplastic composition to temperatures as high as 300°C.

The known processes place production-related restrictions on both the maximum width of the web of cling-fastener sheet and the minimum thickness of the cling-fastener sheet, and the company Velcro Industrie B.V. has therefore developed longitudinal and/or transverse stretching processes, described in PCT WO 98/32349, for producing wider, and very thin, film-type cling-fastener sheet. A disadvantage with this process, besides the large amount of high-cost resource used for production, is that each stretching process markedly reduces the number of interlocking means per unit of area.

The object of the present invention is to provide a novel process and a novel apparatus for producing cling-fastener parts, where these permit production rate to be increased while reducing energy cost. The present invention is moreover intended to permit the provision of cling-fastener parts with greater heat resistance, and also of film structures with extremely low thickness, while providing a large number of protruding elements or interlocking means.

Very surprisingly, it has been found possible to achieve a considerable rise in production rate, while reducing energy costs, by shaping, casting, and/or compression molding a formulation encompassing

radiation-crosslinkable, preferably acrylic, prepolymers, and then radiation-curing. It is also possible to dispense with the use of inert atmosphere if the radiation-crosslinkable prepolymers are suitably selected.

Exceptionally high polymerization rates are achieved in the radiation curing of formulations encompassing radiation-crosslinkable, in particular acrylic, prepolymers, where this takes place by way of UV radiation or electron beam. Compared with the known production processes for cling-fastener parts made from thermoplastics, the process of the invention can give a ten-fold increase in the rate of rotation of the rolls, and therefore in the length of the three-dimensional webs produced per unit of time.

Since polymerization by way of radiation crosslinking does not require any heating of the curable composition, as is required in the known processes, the process of the invention also saves energy.

Another advantage of radiation curing is that the polymerization takes place without releasing cleavage products. Instead, the radiation-crosslinkable, in particular acrylic, prepolymers undergo almost quantitative crosslinking with one another and, where appropriate, also with reactive solvents present.

By using radiation-crosslinkable, in particular acrylic, prepolymers, it is possible to produce heat-resistant cling-fastener parts which can even be used as cling-fastener parts for grinding wheels or other tools, for example. Particularly high heat resistance is possessed by the highly crosslinked acrylic polymers prepared by radiation curing of formulations which encompass bi- and/or trifunctional prepolymers and/or monomers, where these promote formation of crosslinking sites. These polymers, which unlike the known

polyolefins, polyamides and polyesters can be used even at temperatures above 300°C, are essentially thermosets.

It is also possible to prepare polymers with predominantly thermoplastic properties via suitable selection of each of the radiation-crosslinkable prepolymers, and, where appropriate, monomers, by increasing the proportion of monofunctional prepolymers and, where appropriate, monomers.

The properties of the polymers are, of course, also dependent on the chain length and the degree of crosslinking of the prepolymers used.

Examples of radiation-crosslinkable, in particular acrylic, prepolymers which may be used are polyester acrylates, epoxy acrylates, polyether acrylates, silicone acrylates, and urethane acrylates.

The use of urethane acrylates is preferred, since these are radiation-crosslinkable without inert atmosphere. Preferred urethane acrylates are the aliphatic mono-, bi- or trifunctional urethane acrylates, the aliphatic groups contributing to the flexibility of the plastic. It is preferable to use bifunctional aliphatic urethane acrylates. In principle it is also possible to make at least some use of aromatic urethane acrylates of varied functionality. The viscosity of the prepolymers used should preferably be from 3,000 to 60,000 mPa.s.

Other radiation-crosslinkable prepolymers may moreover be used in the formulation. Use of an inert atmosphere and/or an inert gas also permits the use of the following prepolymers:

1. polyester resins or chlorinated polyester resins, or
2. utilizing a cationic crosslinking mechanism

a) cycloaliphatic epoxy resins, or
b) epoxy/polyol blends.

When using radiation-crosslinkable, in particular acrylic, prepolymers the relatively high viscosity mostly requires dilution of the formulation by adding reactive diluents, in particular monomers, to achieve a suitable viscosity. The hardness, degree of crosslinking, and flexibility of the polymeric final product, and also the viscosity of the starting formulation, may be adjusted via suitable selection of the monomers added.

During the polymerization, the monomers are incorporated into the network, and there is therefore almost no release of solvents from the polymer.

When using acrylic prepolymers, the monomeric reactive diluents used are preferably acrylates of varied functionality.

Addition of monofunctional acrylates reduces hardness, increases flexibility, and gives the polymer good adhesion properties. Monofunctional monomers also give lower shrinkage during polymerization. In principle, use may be made of any of the known monofunctional acrylates. The monofunctional acrylates are preferably selected from the group consisting of butyl acrylate, 2-ethylhexyl acrylate, hydroxyethyl acrylate, hydroxypropyl acrylate, 4-hydroxybutyl acrylate, ethyl diglycol acrylate, isodecyl acrylate and 2-ethoxyethyl acrylate, particular preference being given to ethoxyethyl acrylate and isodecyl acrylate.

Adding bi- or trifunctional acrylates also adjusts the properties desired, such as hardness and flexibility. Preferred bifunctional monomers used are diethylene glycol diacrylate, dipropylene glycol diacrylate, triethylene glycol diacrylate, tripropylene glycol

diacrylate, or 1,6-hexanediol diacrylate, 1,6-hexanediol diacrylate being particularly preferred.

It is also possible, if desired, to use trifunctional acrylates, such as trimethylolpropane triacrylate or pentaerythritol triacrylate, or even acrylates of higher functionality.

It is also possible to use propoxylated monomers, which are less skin-irritant.

It is preferable to use a monomer mixture made from mono- and bifunctional acrylates, in particular a mixture made from 2-ethoxyethyl acrylate and 1,6-hexanediol diacrylate. The concentration of each of the monomers added to the formulation depends on the formulation viscosity required, and on the desired hardness, flexibility and adhesion properties of the polymer, and on the reaction rate, etc.

Another mixture which has proven successful is that made from monomer- and bifunctional acrylates, in particular ethoxyethyl acrylate or isodecyl acrylate, with trimethylolpropane triacrylate.

Another advantage of producing the cling-fastener parts from radiation-crosslinkable prepolymers and monomers is that the adhesion properties of the plastic can be controlled via the selection of the monomers used, and that it is possible to achieve sufficient adhesion of the plastic to a desired backing without the additional steps of surface-treatment, by corona discharge, gas flame, or fluorination, required in the case of known thermoplastics. This means that the process of the invention saves one operation.

To achieve sufficient polymerization using UV-curable formulations addition of a photoinitiator is required

to form the primary free radicals which start the chain reaction on excitation by UV radiation.

In principle, the photoinitiators used may be any of the known molecules which liberate free radicals on absorbing UV, for example an α-hydroxyketone, α-aminoketones, dimethyl ketals of benzil, bisbenzoylphenylphosphine oxides, metallocenes and derivatives of these.

It is particularly preferable to use a photoinitiator comprising 2-hydroxy-2-methyl-1-phenylpropan-1-one, for example Darocur 1173 from Ciba Geigy.

Other conventional additives, such as dyes, stabilizers, oxygen scavengers, ferrite powder, may, of course, be added to the formulation.

The viscosity of the radiation-crosslinkable formulation depends on the specific conditions of production, for example the nip pressure between the shaping rolls. The viscosity of the formulation should preferably be from 150 to 20,000 mPa.s, and particular preference is given to viscosities from 300 to 5,000 mPa.s.

The percentage of prepolymers added to the radiation-curable formulation depends on the viscosity required from the formulation, on the properties of the prepolymers and monomers, and on the properties desired in the plastics material to be produced. The proportion of prepolymers in the formulation is generally from about 60 to 95%, preferably about 80%.

There are varied uses for the cling-fastener parts produced according to the invention: the babies' diaper sector or incontinence diapers, heat-resistant cling-fastener parts for securing grinding wheels or of other tools, for securing large areas of carpet, wall

hangings, for seat coverings or seating units, packaging, or fly-exclusion mesh, or else for self-cleaning surfaces.

The thickness of the cling-fastener base and the number of interlocking means per cm^2 depend on the use of the finished cling-fastener parts.

Besides cling-fastener parts, the process of the invention can also produce other films which encompass protruding elements or ribs on at least one side, for example riblet films. One side of riblet films has a large number of protruding elements of a type which reduces wind shear loading and/or controls the separation of boundary layers. Depending on the effects desired from the surface structure, the protruding elements may be shaped like shark skin or like a lotus flower, giving a reduction in drag and/or a self-cleaning effect. Surface structures of this type are described by way of example in "Biological Surfaces and their Technological Application - Laboratory and Flight Experiments on Drag Reduction and Separation Control" by D. W. Bechert, M. Bruse, W. Hage and R. Meyer in "Fluid Mech. (1997) Vol. 338, pp. 59-87 Cambridge University Press".

Riblet films of this type are likewise produced using the formulations encompassing radiation-crosslinkable, in particular acrylic, prepolymers, these being similarly molded between a shaping roll and a backing roll as appropriate, and then radiation-cured, the shaping roll having a large number of cutouts complementary to the riblet structure. The riblet films which can be produced from radiation-curable formulations likewise have a high production rate and exceptionally high heat resistance. Examples of uses of the riblet films are for lowering drag on aircraft or railroads, or in pipelines, for preventing icing of aircraft, or as a self-cleaning film.

The invention will now be described using examples.

Radiation-curable formulations for producing cling-fastener parts

A. *UV-curable formulations*

1. 77.7% by weight of Ebecryl 4835[1] from UCB Chemicals, Drogenbos, Belgium
   9.7% by weight of IRR 184[2] (ethoxyethyl acrylate) from UCB Chemicals
   9.7% by weight of HDDA[3] (hexanediol diacrylate) from UCB Chemicals
   2.9% by weight of Darocur 1173[4] (photoinitiator, 2-hydroxy-2-methyl-1-phenylpropan-1-one) from Ciba Geigy.

   The viscosity of this formulation is about 300 mPa.s.

2. 77.7% by weight of Ebecryl 4835[1] from UCB Chemicals
   9.7% by weight of IRR 184[2] from UCB Chemicals
   9.7% by weight of TMPTA[5] (trimethylolpropane triacrylate) from UCB Chemicals
   2.9% by weight of Darocur 1173[4] from Ciba Geigy, as photoinitiator

3. 9.7% by weight of isodecyl acrylate from UCB Chemicals may also be used in mixing specifications 1 and 2, instead of 9.7% by weight of IRR 184 from UCB Chemicals.

B. *Electron-beam-curable formulation*

1. 80% by weight of Ebecryl 4835 from UCB Chemicals
   10% by weight of IRR 184 from UCB Chemicals
   10% by weight of HDDA (hexanediol diacrylate) from UCB Chemicals

2. 10% by weight of isodecyl acrylate are used instead of 10% by weight of IRR 184 from UCB Chemicals, and/or 10% by weight of TMPTA[5] are used instead of 10% by weight of HDDA.

(1) Ebecryl 4835 is stated by the manufacturer to be a mixture of aliphatic urethane diacrylates diluted with 10% of tetraethylene glycol acrylate. The viscosity at 25°C is about 4,500 mPa.s. The molar mass is about 1,600 g/mol.

(2) IRR 184 is a 2-(2-ethoxyethoxy)ethyl acrylate. The viscosity is stated by the manufacturer to be from about 2.5 to 9 mPa.s at 25°C.

(3) The viscosity of the HDDA is stated by the manufacturer to be 10 mPa.s.

(4) Darocur 1173 is stated by the manufacturer to have overlapping absorption bands in the region from 240 to 400 nm.

(5) The viscosity of the trimethylolpropane triacrylate is stated by the manufacturer to be 115 mPa.s.

Two different apparatuses for producing cling-fastener parts are described below.

Figure 1 shows an apparatus for producing cling-fastener parts on a backing material by UV curing

Figure 2 shows an apparatus for producing cling-fastener parts with no added backing material by UV curing

Figure 3 shows a side view of a detail of a cling-fastener part 26 on a backing 13.

In the apparatus shown in Figure 1, the formulation 14 encompassing radiation-crosslinkable, in particular acrylic, prepolymers to be polymerized, as in mixing specification A1, A2 or A3 is applied in the form of a film 15 of constant thickness d of from 12 to 50 μm, preferably 22+/- 5 μm, to a backing material 13, for example applied by a doctor 10 or by a die.

The backing material 13 used may be a plastics film, e.g. made from Hostaphan, a nonwoven, a textile, or any other suitable backing material.

The film 15 made from the formulation to be polymerized on the backing material 13 is then fed to a gap 16 between a shaping roll 11 and a backing roll 12. The shaping roll 11 has a large number of radial cutouts 17, which are open at both ends. The viscous formulation is compressed through the gap 16 into the shape of a cling-fastener base 21, and in the cutouts, into the shape of the interlocking means 24 (see also Figure 3) encompassing the interlock prominances 22 and interlock tips 23, and is then irradiated by UV light 19 of suitable wavelength. The interlocking means may have various shapes, for example a cross section which is round, triangular, rectangular, pentagonal or hexagonal. The interlock tips 23 may also have a variety of shapes, and may be plate-shaped, mushroom-shaped, arched or hook-shaped, for example. Corresponding embodiments are described in DE 198 28 856.5, which is a subsequent publication.

Absorption of the UV light causes the UV-sensitive photoinitiator to liberate free radicals which initiate the free-radical chain polymerization.

The rate of the polymerization reaction is exceptionally high, and in a fraction of the conventional full curing time the cling-fastener parts 26 composed of the cling-fastener base 21 and of the

interlocking means 24, on the backing material 13, can therefore be released from the shaping roll 11 by means of the take-off roll 20. From about 20 to 30 m of cling-fastener sheeting can be produced per minute. Since the nip pressures required are lower than in the known processes, the apparatus can have wider rolls 11, 12, 20 without any change in precision.

The nip pressure between the rolls 11 and 12 and the UV irradiation also achieves a firm bond between the backing material 13 and the cling-fastener base 21.

In order that the cutouts 17 provided in the shaping roll 11 are completely filled, a slight excess of the formulation is added, so that the bank 25 of radiation-curable composition 14 always has enough starting material available to supply the cutouts 17 in the shaping roll 11.

The direction of turn of the backing roll 12 and of the roll 20 is opposite to that of the shaping roll 11.

The UV source 19 used may be a medium-pressure mercury source. However, it is also possible to use other sources of UV radiation. Depending on the band in which the photoinitiator absorbs with free-radical formation, the wavelength range used for irradiation by UV light is from 180 to 400 nm, corresponding to from about 3 to 6 eV.

The irradiation wavelength depends on the emission spectrum of the source of UV radiation used, and on the band in which the photoinitiator absorbs.

The backing material 13 used should, of course, be substantially resistant to the UV radiation. In addition, although the backing material filters and scatters the UV radiation, it has to be ensured that, within the layer to be cured, there is sufficient

formation of the primary, photochemically generated, free radicals which initiate the chain reaction.

The apparatus shown in **Figure 2**, unlike the apparatus detailed in Fig. 1, serves for the production of cling-fastener parts without any added backing material. The radiation-crosslinkable formulation 14 is present in a storage container 31, and is fed via a die 32 to the gap 16 between the shaping roll 11 and the backing roll 12, there being a small excess of feed, as in the apparatus described in Figure 1.

Due to the high viscosity of the radiation-crosslinkable formulation, the shaping of the viscous composition brought about by the pressure applied is retained until the irradiation has caused substantially complete curing and the cling-fastener parts are released from the shaping roll 11 by means of the take-off roll 20.

If acrylic urethanes are used as prepolymers there is no need to work in an inert atmosphere. If other radiation-curable prepolymers are used, the reaction should be carried out in an inert atmosphere, in order to prevent premature chain degradation brought about essentially by oxygen.

In an apparatus for producing cling-fastener parts by electron-beam curing, use is made of an electron beam source instead of the UV source 19 in the apparatuses described in Figures 1 and 2, and one of the formulations B1 or B2, for example, is used as radiation-crosslinkable composition.

The energy range of the electron beam is usually from 150 to 300 keV.

The production of the cling-fastener parts from radiation-crosslinkable, in particular acrylic,

prepolymers may also take place in other apparatuses operating continuously or batchwise and encompassing means of shaping, casting, and/or compression molding formulations encompassing radiation-crosslinkable, in particular acrylic, prepolymers into the shape of a cling-fastener base with interlocking means arranged thereupon, and which encompass a source of UV radiation or an electron-beam source for radiation curing.

What is claimed is

1. A process for producing cling-fastener parts with a large number of interlocking means (24), characterized in that a formulation encompassing radiation-crosslinkable prepolymers is molded, cast, and/or compression molded into the shape of a large number of interlocking means (24) together with a cling-fastener base (21), and is then radiation-cured.

2. The process as claimed in claim 1, characterized in that the radiation-crosslinkable, in particular acrylic, prepolymers are selected from the group consisting of polyester acrylates, epoxy acrylates, polyether acrylates, silicone acrylates and urethane acrylates, the urethane acrylates preferably being aliphatic mono-, bi- or trifunctional urethane acrylates.

3. The process as claimed in claim 1 or 2, characterized in that the formulation encompasses reactive diluents, preferably monomers, particularly preferably acrylates, the acrylates preferably being monofunctional acrylates from the group consisting of butyl acrylate, 2-ethylhexyl acrylate, hydroxyethyl acrylate, hydroxypropyl acrylate, 4-hydroxybutyl acrylate, ethyl diglycol acrylate, isodecyl acrylate and 2-ethoxyethyl acrylate, and the bifunctional acrylates being from the group consisting of diethylene glycol diacrylate, dipropylene glycol diacrylate, triethylene glycol diacrylate, tripropylene glycol diacrylate and 1,6-hexanediol diacrylate, and the trifunctional acrylates being from the group consisting of trimethylolpropane triacrylate and pentaerythritol triacrylate, and particular preference being given to 2-ethoxyethyl acrylate,

isodecyl acrylate, 1,6-hexanediol diacrylate and trimethylolpropane triacrylate.

4. The process as claimed in any of claims 1 to 3, characterized in that the radiation curing takes place by way of an electron beam.

5. The process as claimed in any of claims 1 to 3, characterized in that the radiation curing takes place by way of UV radiation, and the formulation preferably also encompasses at least one photoinitiator.

6. The process as claimed in claim 5, characterized in that the photoinitiator is selected from the group consisting of α-hydroxyketones, α-aminoketones, dimethylketals of benzil, bisbenzoylphenylphosphine oxides, metallocenes, and derivatives of these, and is preferably 2-hydroxy-2-methyl-1-phenylpropan-1-one.

7. The process as claimed in any of claims 1 to 6, characterized in that the molding, casting or compression molding takes place in a gap (16) between a shaping roll (11) and a backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), where the interlocking means (24) or the protruding elements are formed during passage through the gap (16).

8. The process as claimed in claim 7, characterized in that the viscosity of the formulation at 25°C is from 150 to 20,000 mPa.s, preferably from 300 to 5,000 mPa.s.

9. An apparatus for producing cling fasteners as claimed in any of claims 1 to 8, characterized in that the apparatus encompasses a means of feeding (32, 10) for the formulation (14) encompassing

radiation-crosslinkable, in particular acrylic, prepolymers, and encompasses at least one shaping roll (11) and one backing roll (12), and that the shaping roll (11) has a large number of radial cutouts (17), and that there is a source of UV radiation (19), or an electron-beam source, for the radiation curing of the molded radiation-curable formulation.

Abstract

Process and apparatus for producing cling-fastener parts made from radiation-cured plastics

The invention relates to a process for producing cling-fastener parts with a large number of interlocking means (24), where a formulation encompassing radiation-crosslinkable prepolymers is molded, cast, and/or compression molded into the shape of a large number of interlocking means (24) together with a cling-fastener base (21), and is then radiation-cured.

The invention further relates to an apparatus for producing cling fasteners, where the apparatus encompasses a means of feeding (32, 10) for the formulation (14) encompassing radiation-crosslinkable, in particular acrylic, prepolymers, and encompasses at least one shaping roll (11) and one backing roll (12), and where the shaping roll (11) has a large number of radial cutouts (17), and where there is a source of UV radiation (19), or an electron-beam source, for the radiation curing of the molded radiation-curable formulation (Fig. 1 refers).

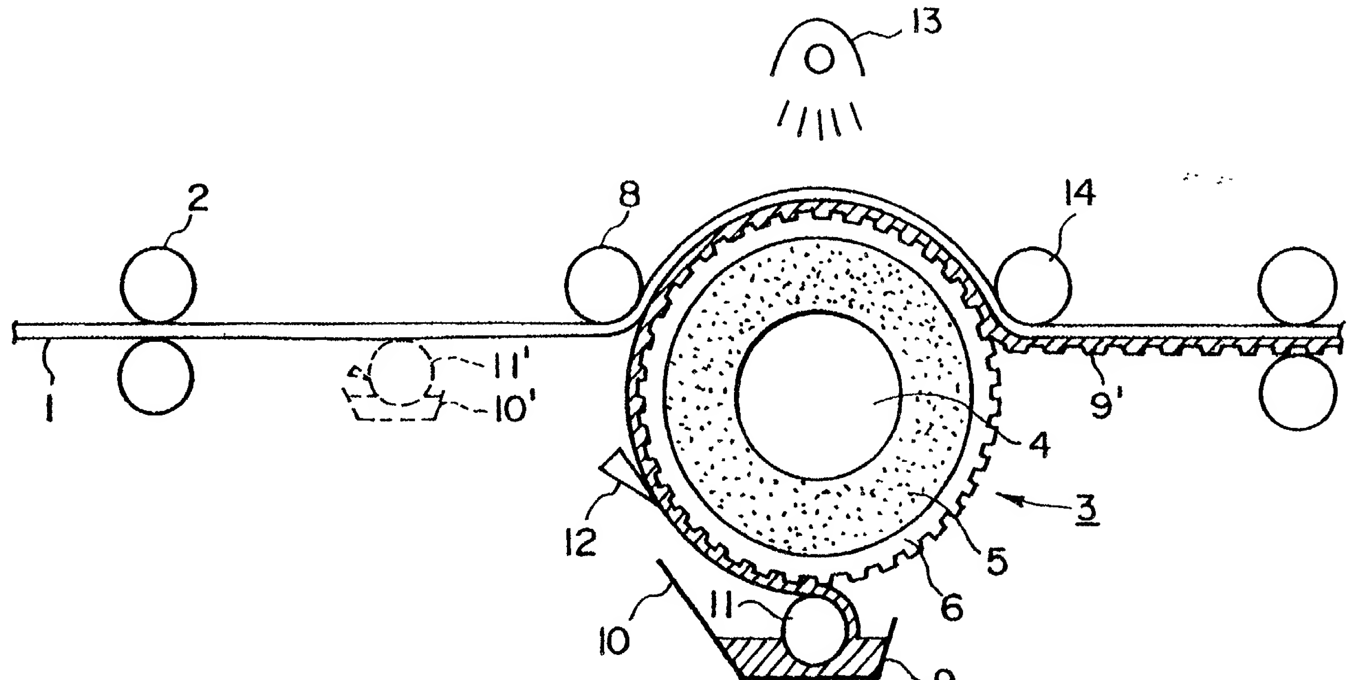

FIG. 1

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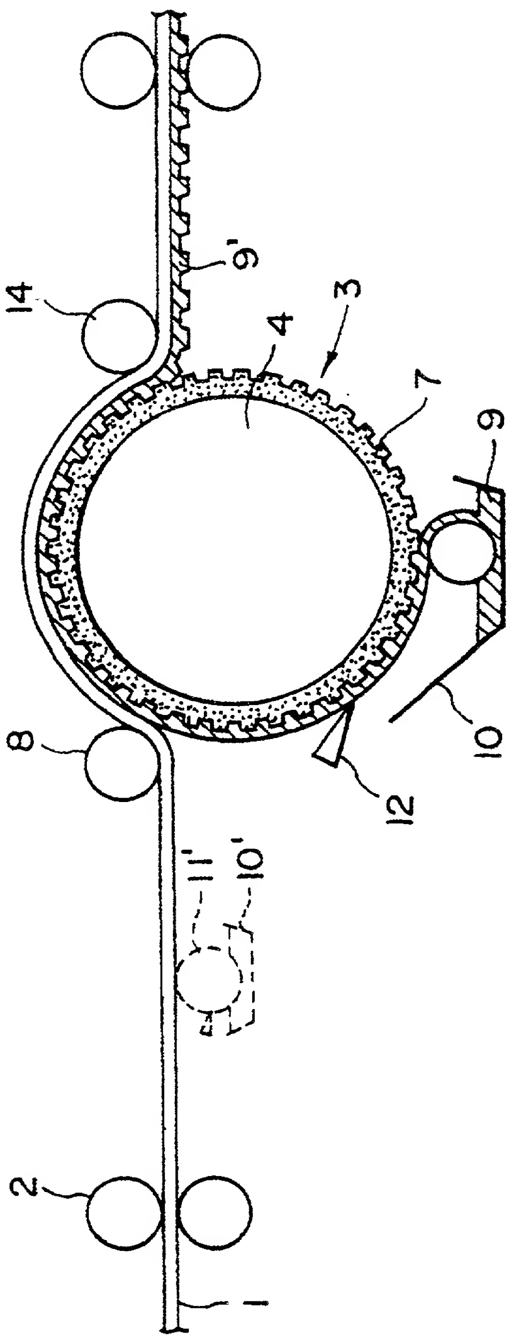

FIG. 2

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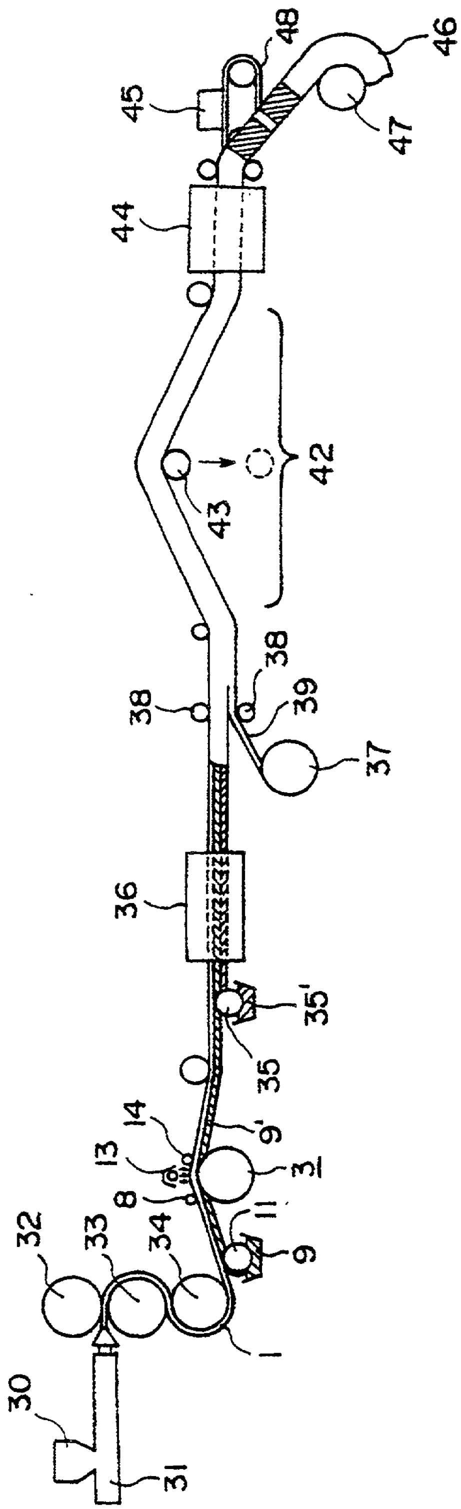
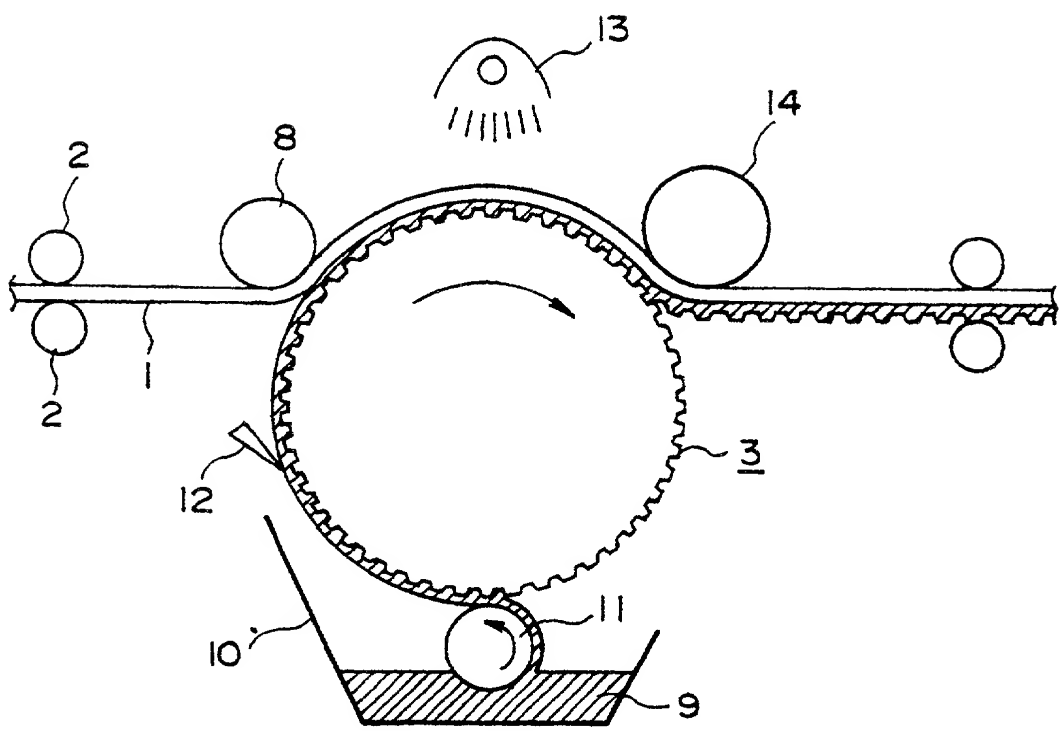


FIG. 3



F I G. 4

Declaration and Power of Attorney for Patent Application
Erklärung für Patentanmeldungen mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

daß mein Wohnsitz, meine Postanschrift und meine Staatsangehörigkeit den im nachstehenden nach meinem Namen aufgeführten Angaben entsprechen, daß ich nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent für die Erfindung mit folgendem Titel beantragt wird:

____

____

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND DEVICE FOR PRODUCING FASTENER PARTS

FROM RADIATION CURED PLASTIC MATERIALS

deren Beschreibung hier beigefügt ist, es sei denn (in diesem Falle Zutreffendes bitte ankreuzen), diese Erfindung

☐ wurde angemeldet am ________ unter der US-Anmeldenummer oder unter der Internationalen Anmeldenummer im Rahmen des Vertrags über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) ________ und am ________ abgeändert (falls zutreffend).

the specification of which is attached hereto unless the following box is checked:

☑ was filed on 22 January 2000 as United States Application Number or PCT International Application Number PCT/EP00/00486 and was amended on ________ (if applicable).

Ich bestätige hiermit, daß ich den Inhalt der oben angegebenen Patentanmeldung, einschließlich der Ansprüche, die eventuell durch einen oben erwähnten Zusatzantrag abgeändert wurde, durchgesehen und verstanden habe.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung jeglicher Informationen an, die zur Prüfung der Patentfähigkeit in Einklang mit Titel 37, Code of Federal Regulations, § 1.56 von Belang sind.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

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Ich beanspruche hiermit ausländische Prioritätsvorteile gemäß Title 35, US-Code, § 119 (a)-(d), bzw. § 365(b) aller unten aufgeführten Auslandsanmeldungen für Patente oder Erfinderurkunden, oder § 365(a) aller PCT internationalen Anmeldungen, welche wenigstens ein Land ausser den Vereinigten Staaten von Amerika benennen, und habe nachstehend durch ankreuzen sämtliche Auslands- anmeldungen für Patente bzw. Erfinderurkunden oder PCT internationale Anmeldungen angegeben, deren Anmeldetag dem der Anmeldung, für welche Priorität beansprucht wird, vorangeht.

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Prior Foreign Applications
(Frühere ausländische Anmeldungen)

(Number) (Nummer)	(Country) (Land)	(Day/Month/Year Filed) (Tag/Monat/Jahr der Anmeldung)	Priority Not Claimed / Priorität nicht beansprucht
199 06 008.8	DE	15 February 1999	☐
			☐

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

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(Application No.) (Aktenzeichen) — (Filing Date) (Anmeldetag)

(Application No.) (Aktenzeichen) — (Filing Date) (Anmeldetag)

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(Application No.) (Aktenzeichen) — (Filing Date) (Anmeldetag) — (Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)

(Application No.) (Aktenzeichen) — (Filing Date) (Anmeldetag) — (Status) (patented, pending, abandoned) (Status) (patentiert, schwebend, aufgegeben)

Ich erkläre hiermit, daß alle in der vorliegenden Erklärung von mir gemachten Angaben nach bestem Wissen und Gewissen der Wahrheit entsprechen, und ferner daß ich diese eidesstattliche Erklärung in Kenntnis dessen ablege, daß wissentlich und vorsätzlich falsche Angaben oder dergleichen gemäß § 1001, Title 18 des US-Code strafbar sind und mit Geldstrafe und/oder Gefängnis bestraft werden können und daß derartige wissentlich und vorsätzlich falsche Angaben die Rechtswirksamkeit der vorliegenden Patentanmeldung oder eines aufgrund deren erteilten Patentes gefährden können.

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10 –

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

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Unterschrift des zweiten Erfinders Datum	Second Inventor's signature Date
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Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address

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(Supply similar information and signature for third and subsequent joint inventors.)